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PERCUSSIVE ARTS CENTRE

183, 8th Cross, 2nd Block, Jayanagar, Bangalore - 560 011.

"R&D ACTIVITIES PERTAINING TO LEATHERS AND WOODS USED FOR PERCUSSIVE INSTRUMENTS"

In our 16th Annual Thaalavaadyothsav held in May 1997 we deliberated on the "50 years of UNESCO". It was at that time decided to examine the "R&D activities pertaining to Leathers and Woods used for percussive instruments" involving Science and Engineering aspects of 'musical instrumentation'. How many recognise the importance of Science and Mathematics in Music is a moot point. The fact that Science and Mathematics have played a vital role in the evolution of music especially musical instruments is still to be emphasised.

Occasionally, musical instruments have been subjected to scientific study and analysis like the experiments on Mridanga and Tabla by Dr. Sir C.V.Raman which are confined to laboratories; the musicians who are most concerned were conspicuously absent. Instrumentation has to be examined for various angles like Craftsmanship, Science and Performance duly participated by physicists, musicians and craftsman etc. The instruments have undergone several changes passing through several stages of evolution. We cannot and should not overlook the involvement of Engineering in these instruments; we should think of utilising the application of modern Engineering technology to study, analyse and develop the percussions to make them superior to what they are now, to make them available easier, cheaper and also to better & enrich the performance techniques. We still follow the hit and low, the trials in tuning, trial and error methods in fabrications resulting in poor accuracy. It is time that Physicists, Engineers, Musicians, Artisans-Craftsman get together to interact seriously and find out ways of production of superior instruments and thus enrich the field by fresh ideas. We should provide these ideas and make the percussion artist more conscious of the need for methodical, rational

approach to solve the problems and work together with men of science, rather than in isolation. Science can make definite contribution in respect of materials used and their properties, vibrational aspects etc. It is in this direction that a symposium had been arranged; the expert body formed then is expected to focus on these, deliberate and come to definite plans and proposals.

A symposium was held in may 1998 on **"R & D activities - Leathers & Woods for Percussions"**. This preliminary survey was chaired by S.N. Chandrashekar, noted art critic, Dr N. Somanathan, Scientist, Central leather Research Institute, Madras presented a paper highlighting the Laboratory studies on Leathers and Woods used for Percussion. A.Veerabhadraiah presented certain details on these aspects. Te.Ve. Gopalakrishnan explained some of his own experimental works regarding these. Short Term and Long Term arrangements for providing required quantity of desired quality were discussed. **An expert body was recommended to go into details like drawing suitable specifications, marketing, survey of available resources etc.**

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SCIENTIFIC STUDY ON LEATHERS AND WOODS USED IN MUSICAL INSTRUMENTS

N.Somanathan Scientist, Central Leather Research Institute, Chennai-600 020.

There are innumerable number of membranophones, used in this country. These instruments have a distinct name, shape, construction, technique of playing and quality of tones. Common features of these drums is that, hides and skins are used in the construction of all drums.

The type of instrument used for a specific purpose has a direct relationship with the tonal quality of the sound produced.

Drums for different purposes have different size, shape and different in construction.

In order to cope with the end use, the construction and the material used in these instruments has to be unique. "Panchamarabu" a Tamil book, which speaks about the grammar of music and dance, gives details about instruments and which leather should be used for which instruments and also the woods to be used for making the resonators.

Ancient literature shows that animal skin was employed in the vedic age. At that time probably skins were the only available material for drum-making. But even today, the Indian drum makers use skins, that too raw skins. Though there are advancements in leather, plastic and fibre science and technologies, the drum makers prefer only raw skins. They sincerely believe that nothing can replace raw skins.

Howard C Hardy et al compared the acoustical performance of bass drums with calf skin and mylar plastic. They reported that the calf skin affords a much wider range of tension adjustment as observed by audible pitch changes, thus allowing for different playing conditions.

Mechanical tests have shown that the calf skin head is superior to the plastic head in withstanding extended beating at the same position on the drum heads.

In order to know the physical and structural relation of the skin with the sound produced, the cross sectional features of leather used in different instruments were studied. A part from this some sun dried skins of common animals were also studied.

Mizhavu (goat skin), iddkkai (stomach lining), chenda (cow leather), kudamuzhuvu(deer skin)

In various skins horizontal fibres running predominantly along the scales direction and the net work structure flows perpendicular to the scales direction.

In goat skins, there is no horizontal running of fibre bundles and the fibres is in loose weaving. In sheep skin, the grain layer is comparatively larger than that of goat skin and fine fibres predominantly running along the hair follicles direction. The cross sections are plain and compact in cow calf leather. The fibres are glued together and from separate blocks in all directions.

The theory of circular membranes considers them as two dimensional stretched strings. The fundamental frequency can be related as

$$f_{01} = \frac{0.382\ T}{R\ \sigma}$$

where f_{01} = fundamental frequency,

R = radius of the membranes

T = circumferential tension/unit length

(σ) = mass/unit area of the membrane

The pitch of the membrane, as in a stretched string depends on the size and weight of the membrane and the amount of tension it is under. The pitch lowers, as the size or weight is increased and rises when the tension is increased.

In the case of drums, the sound produced by it depends on the resonator column and the properties of leather, the loudness depends on the amplitude, energy and the intensity.

The major constituent of leather is collagen fibres. The three dimensional network of these fibres is different animals. The structure is stable up 0 a certain temperature and above that temperature the fibres gelatinize and the three dimensional network changes altogether.

During sun drying, due to the removal of water, the structure changes and the final leather produced, has different structures in different animals skins. The packing of fibres structures varies in the same leather, at different locations. The portion taken from the butt region is compact and the portion taken from belly region has loose structure.

The fibre bundles which forms like a string induces and help to produce more sound. When the angle of run of the fibres is varied, the effect produced is dissipated in all the directions.

Anatomical studies were undertaken in vertical, radial and tangential directions. The moisture sorption characteristics and density of the woods were also studied.

The results show that the jack wood has more fibrous structure than the other. The packing of the fibres is also very high. The pores present in jack wood is

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The results show that the jack wood has more fibrous structure than the other. The packing of the fibres is also very high. The pores present in jack wood is less when compared to the other three. The pore size and distribution of the material can be inversely proportional to the modulus of the wood. the density of jack wood is also less when compared to other woods.

$$V=E/P$$

where V=velocity of sound, E=modulus, P=density

Therefore the velocity of sound will be more when the pore size and distribution and the density is less.

The moisture absorption characteristics were also good for jack wood when compared to other woods. Moisture present in the system reduced the velocity of sound.

Due to the chemical substances present in jack and neem woods, these woods were not easily affected by white ants and fungus, when compared to mango.

These studies on woods reveal that in all respects, **jack wood is superior to other woods for making the resonator and it will not produce any adverse effect on the sound produced in a musical instrument.**

In the next stage, during the manufacture of musical instruments, there are lot of problems faced by the instruments makers. For example, the non-availability of specific type of leather for making the instrument. If we take kanjira, literature shows that deer skin was used in kanjira. But currently varanus skin is used for it. But now, killing reptiles and wild animals for their skins is prohibited.

In that case what can we do for making kanjira? We definitely need a substitute for varanus skin. We need a substitute which has similar physical structure and must produce the same sound. Studies on Kanjira

with different skins reveal that bandicoot skins can be used in kanjiras instead of varanus. Sound analysis of kanjiras made with varanus and bandicoor shows that the sound characteristics were similar with both skins. The feel of the instrument made with bandicoot was tested by 3 players. (one mridangam player, one kanjira player and another player who plays both mridangam and kanjira). They reported its suitability and can form a substitute for varanus skins.

Even in mridangam, previously the right head made from 3 layers of cow hide. But now the middle layer has been substituted with goat skin.

Therefore even if there is a problem in getting the skins, a **proper substitute can be found out depending on the structure of the skin.**

In conclusion, if we study the physical structural correlations and size of the instrument with sound, the available material can be made use of to solve the availability problem of materials.

Research and Development is part of any evolving artistic tradition and the percussive arts are no exception to it. While instruments like Khanjira and Morsing pose no problems in transportation because of their handy shape and size-e, it is Mridangam to a greater extent and Ghatam to a lesser extent which becomes unwieldy. Also Mridangam is a highly sensitive instrument and gets easily affected by the prevailing weather conditions. **Research is called for in the area of developing improved versions of instruments as can withstand the vagaries of weather and facilitate easy transportation** over long distances with a reduced size and weight but without compromising their unique tonal qualities.

With the percussive arts now rightly coming into their own, one hopes that this would stimulate the exploration of newer dimensions in music.